Late Traumatic Corneal Wound Dehiscence After Penetrating Keratoplasty

Penetrating keratoplasty wound dehiscence usually occurs early in the postoperative period and is associated with premature suture removal, abnormal wound healing, sudden increases in intraocular pressure, corneal edema, and trauma. Binder et al noted in their series an incidence of full-thickness wound separation or partial wound gape of 5.7%; all cases occurred within the first 2 years following the initial surgery. Penetrating keratoplasty wound separation infrequently develops late in the postoperative course and usually results from direct trauma. In a series by Raber et al on traumatic wound dehiscence following penetrating keratoplasty, all cases occurred within 18 months of the initial surgery. However, one of the most recent cases of traumatic penetrating keratoplasty wound dehiscence reported in the American literature occurred 13 years after initial surgery. In the European literature, Rohrbach et al noted one case occurring 25 years after grafting.

At the Wilmer Eye Institute (Baltimore, Md), we followed up 6 patients who had sustained traumatic penetrating keratoplasty wound dehiscence 10 to 19 years after initial surgery. To our knowledge, this is the largest reported series of graft dehiscence occurring a decade or more after penetrating keratoplasty.

Report of Cases. Case 1. A 79-year-old white woman who had undergone penetrating keratoplasty for aphakic bullous keratopathy 19 years earlier injured her right eye while trying to remove a rigid contact lens. When she was unable to remove the contact lens, she enlisted the assistance of a neighbor, who attempted to remove the lens using a contact lens plunger. After repeated attempts, they were unable to retrieve the lens. During the episode, the patient noticed some pain and decreased vision. The next morning, as she bent down to pick an object off the floor, she noticed sharp pain in her right eye and an acute reduction in her vision. On examination at the Wilmer Eye Institute, her vision was light perception, and she was noted to have a choroidal hemorrhage with kissing choroidal. Her graft had dehisced inferiorly for 4 clock hours, with incarcerated iris plugging the wound (Figure 1). The wound was repaired the same day, with a postoperative best-corrected acuity of 20/400 (Figure 2). Her graft has remained clear since repair 3 years ago.

Case 2. A 79-year-old white woman with an extensive past medical history who had undergone penetrating keratoplasty for Fuchs endothelial dystrophy in her right eye 16 years earlier injured her right eye. She slipped in her kitchen, striking her eye against the edge of a freezer. On examination, she had light perception vision in the right eye, with 8 clock hours of graft dehiscence temporally and uveal prolapse. Because of her poor overall health and because she had recently eaten, the decision was made to postpone the repair until the following day. By the next morning, an expulsive choroidal hemorrhage had occurred, and an evisceration was subsequently performed (Figure 3).

Case 3. A 36-year-old African American man had undergone penetrating keratoplasty for keratoconus in his left eye 17 years before he suffered the current football injury that affected this eye. Examination revealed a temporal graft dehiscence of approximately 5 clock hours, with extrusion of the crystalline lens and iris prolapse through the wound. The corneal dehiscence was repaired at a local hospital. The patient later recovered a best-corrected visual acuity of 20/25. His graft has remained clear since repair 2 years ago.

Case 4. A 55-year-old white man underwent penetrating keratoplasty for keratoconus 18 years prior to sustaining a racquetball injury to his left eye. At the time of injury, he had been wearing polycarbonate sports safety goggles, but the force of impact caused the protective spectacles lens to dislodge from the frame and strike his left eye. Although the lens remained unshattered, the pa...
A 10-clock-hour keratoplasty dehiscence. The injury also resulted in crystalline lens expulsion, superotemporal iridodialysis, and a peripheral tractional retinal detachment. Within several hours of the injury, the patient underwent exploration and repair of the open globe injury with resuturing of the corneal graft at a local hospital. Five days later, he underwent a pars plana vitrectomy, scleral buckle, peripheral endolaser treatment, and iris reconstruction. Three months later, his best-corrected visual acuity with an aphakic rigid gas-permeable contact lens was 20/30. His graft has remained clear since repair a year ago.

Case 5. An 82-year-old white man underwent a penetrating keratoplasty for lattice corneal dystrophy in his left eye 11 years prior to his current injury. His left eye was struck with a basketball. Interestingly, this patient was wearing prescription glasses with polycarbonate lenses, which did not shatter but became dislodged from the frames by the force of the basketball. When seen the day after his injury, his vision was noted to be 5/200. Slitlamp biomicroscopic examination revealed a 3-clock-hour superonasal graft dehiscence with incarcerated iris plugging the wound. There was no apparent injury to the lens or posterior segment. The patient underwent a wound repair, iris reposition, and anterior chamber reformation the same day. One week postoperatively, his vision was 20/200 with his previous spectacle correction. His graft remains clear 9 months after repair.

**COMMENT**

We report here 6 occurrences of traumatic wound dehiscence occurring 10 to 19 years after penetrating keratoplasty. Most cases of keratoplasty wound dehiscence occur soon after the removal of sutures, presumably as a result of incomplete wound healing. The cases in our series all occurred nearly a decade or more following the removal of sutures. All of the patients in our series discontinued treatment with topical steroids at least several years prior to their injuries.

Calkins et al, using the holographic stress test, demonstrated that the strength of the graft-host interface is weak even if the wound appears to be fully healed. In a rabbit
model, Gassett and Dohlman\textsuperscript{8} demonstrated that at 3 months following keratoplasty, the tensile strength of the corneal wound is only 50\% that of the normal intact tissue. In fact, in human studies, this same level of tensile strength is not achieved until 2 to 3 years postoperatively.\textsuperscript{9} This supports the assertion that normal corneal wound healing occurs mainly at the endothelial and epithelial junctures but not at the level of the stromal keratocytes. The Descemet membrane is reelaborated by the endothelial cells and bridges the keratoplasty interface. However, the Bowman layer, which represents a condensation of the anuclear anterior stroma, is not regenerated. The lamellar cut-ends within a corneal wound are probably reconnected by a tangle of new collagen fibrils deposited within the wound that intercalate the adjacent stromal lamellae rather than by reanastomosis.\textsuperscript{10} This is further supported by experience with laser-assisted in situ keratomileusis flaps, which can become dislocated or surgically lifted years after they were initially created. Moreover, our experience with penetrating keratoplasty grafts several years following initial transplantation shows that the graft-host interface can simply be pried apart with a pair of 0.12-mm forceps with no sharp dissection necessary. Even with vascularization at the graft-host junction, the structural integrity of the corneal wound site remains weak. The occurrence of keratoplasty wound dehiscence as late as 19 years after initial surgery in 1 patient in our series suggests that corneal wounds never achieve the strength of the normal cornea. Moreover, the prolonged use of topical corticosteroids to prevent graft rejection undoubtedly prolongs the weakness of the corneal graft-host interface.\textsuperscript{11}

Based on our experience with late penetrating keratoplasty dehiscence, an immediate wound repair using the original graft should be performed, even if the graft appears edematous and opaque at the time of injury. Topping et al\textsuperscript{11} reported on 4 similar cases of traumatic corneal graft dehiscence in which the initial graft was edematous following trauma. In their series, patients underwent primary resuturing. All the grafts slowly underwent deturgescence and regained excellent clarity, which was maintained during a follow-up period of 23 months to 5 years.\textsuperscript{12} This was also noted in our series where all grafts, save the case requiring evisceration, cleared.

Three of the 6 patients developed choroidal hemorrhages, likely induced by delay in surgical intervention in a nonpressurized eye and their advanced ages, ranging from 79 to 82 years. Even when general anesthesia is contraindicated, the graft can be sutured under topical anesthesia to pressurize the eye and prevent an expulsive hemorrhage. Retrobulbar anesthesia would be contraindicated in these types of injuries because of the risk of globe perforation with the retrobulbar needle in an open, distorted globe. Sub-Tenon anesthesia, using a blunt cannula, could be considered, however.

In conclusion, it is our assertion that corneal graft wounds never fully heal. It is unfortunate that safety

Figure 3. Temporal graft dehiscence with uveal prolapse and an expulsive choroidal hemorrhage. A preoperative photograph from case 2.

Figure 4. Inferior graft dehiscence with an expulsive choroidal hemorrhage. A preoperative photograph from case 5.
glasses did not prevent injury in 2 of the patients. Despite this, we espouse the strict use of safety glasses that comply with the American National Standards Institute Z87.1 safety glass standard by all patients after penetrating keratoplasty in the hope of preventing these serious and often devastating ocular injuries. For sports activities, Prevent Blindness America recommends that athletes wear sports eyeguards with polycarbonate lenses that either stay in place or pop outward in the event of an accident. Patients who have undergone keratoplasty should be cautioned as to the possible risk of dehiscence, especially during contact sports, even when wearing proper safety eyewear. Moreover, corneal sutures may be left indefinitely if they remain intact and are not inducing significant astigmatism. We routinely leave graft sutures in place for a minimum of 2 years following surgery and then remove them only if they are an impediment to visual rehabilitation or become broken.

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Aggressive Retinal Astrocytoma in 4 Patients With Tuberous Sclerosis Complex

Retinal astrocytic hamartoma is the best-known ocular manifestation of tuberous sclerosis complex (TSC). It is generally a sessile or slightly elevated lesion in the nerve fiber layer of the retina, but it can have several clinical variations. It can be unilateral, bilateral, solitary, multifocal, transparent, opaque, noncalcified, or calcified. Retinal astrocytic hamartoma in association with TSC generally is considered to be a relatively stationary lesion that has little potential for aggressive behavior. In rare instances, however, a retinal astrocytic hamartoma can show progressive growth and cause severe local complications. We report the clinical course and histopathologic findings in 4 patients with TSC, each of whom developed progressive growth of a juxtapapillary astrocytic hamartoma that caused secondary retinal detachment and neovascular glaucoma, necessitating enucleation of the affected eye.

Methods. The clinical records and histopathologic findings were reviewed and summarized on 4 patients with TSC who underwent enucleation of 1 eye because of tumor growth and neovascular glaucoma. Clinical findings evaluated included patient age at enucleation; patient sex; tumor dimensions; and frequency of retinal exudation, retinal detachment, neovascular glaucoma, and extraocular extension. Assessment of pathology findings included review of grossly sectioned eyes, histopathologic sections, and immunohistochemical preparations. The literature on aggressive retinal astrocytic neoplasms that came to enucleation was reviewed, and a comparison was made between those associated with TSC and those unassociated with TSC.

Results. In the computerized files of the Ocular Oncology Service at Wills Eye Hospital, we identified 4 cases of aggressive astrocytic retinal tumors associated with TSC that required enucleation. The TSC in each patient was characterized by hypopigmented cutaneous macules, facial angiofibromas, and subependymal or cortical lesions typical of TSC seen with computed tomography or magnetic resonance imaging. One patient had renal cysts and none had cardiac, lung, or other lesions of TSC.

Concerning ocular manifestations, each patient had a similar clinical course, characterized by progressive enlargement of a previously recognized yellow retinal juxtapapillary mass (Figure 1) that ultimately caused a blind painful eye and necessitated enucleation. In addition, 3 of the 4 patients had multiple retinal astrocytic tumors in both eyes, and only 1 patient had a solitary retinal tumor.

The pertinent clinical information on our 4 cases is summarized in Table 1. There were 2 boys and 2 girls. Each tumor was surrounded by yellow intraretinal exudation that was documented to slowly progress to a total exudative retinal detachment and neovascular glaucoma. This progressive exudation and retinal detachment appeared to be directly related to gradual enlargement of the tumor. The intervals from the initial diagnosis of retinal tumor to enucleation ranged from 6 months to 13 years. In the latter patient with the 13-year interval, enucleation had been advised at age 7 years, but the patients refused and only consented to enucleation when the tumor caused perforation of the globe 6 years later. Based on clinical estimation and ultrasonography, the tumor sizes at the time of enucleation ranged from 12×8×9 mm to 20×20×25 mm, with the latter (case 4) being the tumor that filled the entire globe and perforated the cornea. Seven years earlier, that tumor measured 8×8×4 mm, attesting to the relentless slow growth that characterized all of the tumors.

Table 1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Tumor Location</th>
<th>Tumor Size (mm)</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>M</td>
<td>Right eye</td>
<td>12×8×9</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>F</td>
<td>Left eye</td>
<td>20×20×25</td>
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<tr>
<td>3</td>
<td>8</td>
<td>F</td>
<td>Right eye</td>
<td>12×8×9</td>
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<td>4</td>
<td>13</td>
<td>F</td>
<td>Right eye</td>
<td>20×20×25</td>
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grading from new digital capture systems that were optimized to detect age-related macular degeneration lesions with data from ongoing epidemiological studies (eg, the Beaver Dam Eye Study) grading from color, 30°, stereoscopic film slides on a light box using standardized grading protocols. The details of display are not the only factors that require standardization and reporting; the methods used to manipulate the images digitally also need to be carefully reported. Beyond standardization of the equipment used to capture and assess the image, both the training of those obtaining the image and detecting the lesions and the grading system used to assess the presence and severity of lesions in the image are important for ensuring high-quality, reproducible results in epidemiological and clinical studies.

Error in Author Name. In the Clinicopathologic Reports, Case Reports, and Small Case Series article titled “Late Traumatic Corneal Wound Dehiscence After Penetrating Keratoplasty,” published in the June issue of the ARCHIVES (2005;123:853-856), the first author’s name should have appeared as follows: Damon J. Pettinelli, MD. The ARCHIVES regrets the error.

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